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ABSTRACT

In this investigation, methodological and substantive issues regarding early mastery motivation (also termed competence motivation and effectance motivation) were examined longitudinally using a primarily middle-class sample of 37 children observed at 1 and 3.5 years of age. Data on cognitive competence and mastery motivation were collected in order to accomplish (1) a psychometric evaluation of the instruments used to assess mastery motivation; (2) an exploration of the interrelations between cognitive competence and motivational functioning; and (3) an examination of the continuity of these relationships over time. Measures at 1 year of age included play assessments focusing on exploratory behavior in free play, executive functioning in elicited play, and cognitive competence. At follow-up assessments when the subjects were older, observations were made of children's spontaneous exploration of the Banta Curiosity Box; cognitive competence was again assessed. Standardized measures of cognitive competence included, at time 1, The Bayley Scales and, at time 2, The McCarthy Scales. Results, which indicated continuity in child functioning between 1 and 3.5 years of age, are discussed. (RH)

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EARLY MASTERY MOTIVATION:

HOW CAN WE MEASURE IT AND WHAT DOES IT MEAN?

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Introduction

Current interest in mastery motivation (also termed effectance motivation and competence motivation) stems principally from the writings of Robert White (1959). White proposed that children have an innate motivation to exert control over their environment, to master problems, and to gain competence in dealing with the world around them. According to White, there is gratification very early on in producing observable effects on the environment. Discovering and exercising influence over persons, objects, and events becomes the cornerstone for a developing self-awareness, for a view of self as causal agent, and for the growth of ego.

Both White's conceptualization and empirical work by Harter (1978, 1980) on mastery motivation in schoolchildren raise a number of issues concerning the potential impact of mastery motivation on competent functioning in a number of realms. It is probable that a child's motivation to gain mastery over new challenges will increase efforts to acquire knowledge and skills across different contexts, including the classroom setting. These efforts, in turn, are likely to enhance performance, to generate success experiences, and, ultimately, to have an impact on children's self-concept, self-esteem, and self-efficacy.

Despite widespread recognition of the role mastery or effectance motivation may play within academic settings, at the very least, the question of individual differences and, especially, of the developmental origins of this construct remain unanswered and, for the most part, unaddressed. Little is known about mastery motivation during infancy -- how it is expressed, when it can first be measured, what role it plays in shaping early behavior. It is likely that the dearth of information about the early nature and development of mastery motivation results from difficulty in conceptualizing and operationalizing such an elusive construct. Nevertheless, valid measurement of early motivational functioning is the crucial first step in learning how early motivational differences affect later functioning.

In order to study the construct of mastery motivation empirically, researchers have operationalized motivational expression in four interrelated ways: (1) as sustained attention to environmental stimuli (Kopp & Vaughn, 1982), (2) as persistence in task-directed behaviors (Morgan & Harmon, 1984; Yarrow, 1976), (3) as responsivity and task-orientation during standardized testing (Epstein & Radin, 1975; Matheny, Dolan, & Wilson, 1974), and (4) as the extent to which performance approximates competence during free play (Belsky & Garduque, 1982; Belsky, Garduque, & Hrncir, 1984).

Common to each approach is the goal of capturing behavior that indicates interest on the part of the infant or young child in discovering information or achieving some desired effect. The emphasis is on effort not effect, process not product. Although within each pair the two are, in all likelihood, related, it is not the competence per se, but the motivation for competence that is critical in this case.

Operationalizing Infant Mastery Motivation

The investigative work of Yarrow and his colleagues represents the main body of research in this area (Jennings, Harmon, Morgan, Gaiter, & Yarrow, 1979; Morgan & Harmon, 1984; Yarrow, 1976; Yarrow, MacTurk, Vietze, McCarthy, Klein, & McQuiston, 1984). These researchers have defined mastery motivation operationally as "the amount of task-directed behavior during the presentation of a set of toys that pose problems to be solved or completed" (Morgan & Harmon, 1984, p. 10). The emphasis is on

infants' persistence in attempting to produce various effects through manipulations of a set of toys made available to them.

In the absence of any striking patterns of results, these investigators have, nonetheless, drawn some tentative conclusions--or, more often, have constructed several empirically derived hypotheses--about the utility of infant exploration as a window from which to view mastery motivation. Among other things, their data suggest that it is the quality (efforts to reach "solutions" or have "effects") rather than the quantity (duration) of play that serves most properly as an index of mastery motivation (Jennings et al., 1979). More accurately, it is the persistent use of developmentally sophisticated exploration and exploration thought to represent practice of "emerging skills" that appear to tap best the construct of mastery motivation.

Hrncir (1984, 1985) employs a comparable measure of mastery motivation based on the amount of cognitively sophisticated play exhibited during an unstructured play period. Rather than presenting infants with a series of individual toys, as in the Yarrow et al. paradigm, Hrncir provides her infants with a preselected group of toys and observes their spontaneous interactions with the toys they choose to explore. Her "spontaneous mastery" score represents a weighted sum of higher- versus lower-level play acts exhibited during exploration.

Both of the assessment techniques just described differ in a fundamental way from standard approaches to measuring cognitive competence (Bayley, 1933; Gesell & Amatruda, 1947; Uzgiris & Hunt, 1975). Traditional tests of cognitive functioning are measures of maximal performance. In contrast, assessment of mastery motivation is an effort to reflect the performance level an infant typically exhibits under more natural circumstances. In this regard, researchers assessing motivation are clearly trying to capture a somewhat different phenomenon. In its operationalization, however, critics may ask whether both Yarrow's and Hrncir's techniques aren't unduly influenced by infant cognitive competence. The problem is that both measures base motivation scores on the amount of cognitively sophisticated play exhibited by the infant. A less competent infant who persistently employs the highest level skills of which s/he is capable scores unfavorably in comparison to a relatively more competent infant who only occasionally uses the higher level skills of which s/he is capable. Cognitive competence and motivational expression are entirely confounded in both measures.

In part as a response to this problem, Belsky and his colleages developed a somewhat different method to measure infant mastery motivation (Belsky, Garduque, & Hrncir, 1984; Belsky & Hrncir, 1982). According to Belsky's conceptualization, motivation to acquire information and to gain mastery over the environment is demonstrated by consistently engaging in the most sophisticated level of exploration of which the infant is capable. The emphasis is thereby shifted from an absolute standard of "mature" or competent play to an individually defined standard of exploratory competence. Persistent deployment of the abilities possessed by the infant, rather than persistence at some externally defined level of exploration, serves as the criterion for inferring the expression of mastery motivation. Procedurally, this implies determining the most cognitively sophisticated play act of which the infant is capable, accomplished through an elicitation exercise following free play. Comparison of this competence level with the level of sophistication observed during free play serves as the measure of mastery motivation exhibited by the infant.

Interrelations between Motivation and Competence

Although conceptually distinct, the methods proposed by Belsky and by Yarrow and Hrncir all derive from a common view of differences in object exploration as differences in the expression of motivation for mastery. This is an historical departure from the more restricted view of infant exploration as a reflection of cognitive competence. It is not, however, a surprising departure when viewed within a developmental model that postulates dynamic and mutually energizing relations between mastery motivation and cognitive growth and competence. On a theoretical as well as a practical level, one would expect to find that cognitive competence and motivation covary. Within the constraints of a restricted database, this is just what one finds.

Jennings and his colleagues (1979) identified a direct association between "cognitively mature" play and both qualitative and quantitative ratings of persistence in task-oriented behavior during play sessions at one year. In a related study, these same researchers reported that persistence ratings at one year correlated with the number of toy "solutions" or "effects" discovered (demonstrating cognitive sophistication) and with mental development scores on the Bayley Scales (Yarrow, Morgan, Jennings, Harmon, & Gaiter, 1985). Relying, instead, on the rating scales that often accompany standardized developmental tests, Matheny, Dolan, and Wilson (1974) and Epstein and Radin (1975) found concurrent relations between the style with which children approached test items and the test situation and their level of performance on that test.

An obvious problem with all but the studies conducted by Jennings and Yarrow (1979, 1985) is the fact that motivational assessment is not independent from assessment of cognitive competence. Competence and motivation are evaluated within the same situation by the same individual. Nevertheless, the data suggest that at any given point in time, one can expect to find relations between the two, although the strength of those relations will probably depend upon the nature, timing, and similarity of the measures used to assess each.

Stability in Motivational Functioning

Moving to relations that endure over time, one generally finds some stability in behavioral indices of motivation, as well as linkages within and across time with cognitive competence. Relations tend to be specific and scattered, however, especially after the first 1 1/2 to 2 years of life. In Hrncir's (1984, 1985) work, for example, a "spontaneous mastery" index during free play predicted attentiveness during a parent teaching task at two years. Although spontaneous mastery and engagement level during play were correlated at each of three observation points (12, 18, 42 months), it was engagement that predicted later mastery scores rather than the other way around. At the same time, both engagement and spontaneous mastery shared almost a third of their variance with performance on standard mental tests given concurrently, highlighting the confound between motivation and competence that probably exists for all three measures...and, additionally, for the constructs as well.

However, Hrncir also presented data indicating a lack of such stability in Belsky's competence-performance measure of motivation from 12 to 18 months. This is not surprising given that his measure is based on only two pieces of data--the single highest free play act and the highest elicited act, both of which are subject to ceiling effects when one moves out of the age range represented on their scale. Consequently, the most conceptually sound ("pure") motivational measure, Belsky's, may lack reliability.

Based on data from their structured play assessments, Jennings, Yarrow, and Martin (1984) reported significant competence and motivation correlations from one year to 3 1/2 years that differed according to the gender of the child. Among boys, 12-month persistence during structured play predicted three-year ratings of persistence at developmentally relevant tasks, exploratory curiosity, and task-orientation displayed during McCarthy testing. Bayley performance predicted one of the three 42-month motivation measures as well. Among girls, in contrast, both one-year persistence and one-year Bayley scores correlated with later competence, the perceptual performance score on the McCarthy Scales.

Together these data suggest, first, that one can view infant cognitive functioning as a system in which competence and motivation, both broadly defined, are very much intermeshed, and second, that standard infant developmental scales capitalize on these relations. At the same time, though, initial psychometric evaluation provides only modest support for beginning efforts to operationalize mastery motivation during the infancy period. A first challenge, then, is to create or refine a measure of mastery motivation that can demonstrate some short-term stability and construct validity--both convergent and discriminant.

In this investigation, methodological and substantive issues regarding early mastery motivation were examined longitudinally using a primarily middle-class sample of children observed at 1 and 3 1/2 years. Data on cognitive competence and mastery motivation were collected to accomplish three goals: (1) psychometric evaluation of the instruments used to assess mastery motivation, (2) exploration of the interrelations between cognitive and motivational functioning, and (3) examination of their continuity over time.

Methods

Sample

Thirty-three of 57 predominantly middle-class preschoolers who had participated in all phases of an earlier investigation of infant and family development over the first year of life were available and able to participate in a longitudinal follow-up study in the fourth year. Four additional youngsters on whom some portion of their previous data was missing also participated in the follow-up study. Ten families had moved from the area and 14 refused further involvement in the project.

Approximately half the children participating in the follow-up study were male (males = 17; females = 20) and slightly over half were firstborns (firstborns = 22; laterborns = 15). Three of the children were living with their mothers only at the time of the follow-up visit as a result of parental separation or divorce. The remaining children all lived in two-parent households.

Procedure

Within the context of a larger study of both infants and their parents, several observations and assessments of infant and child functioning were conducted across a span of 2 1/2 years. Infants were observed in the laboratory for a play session at 12 and at 13 months of age, at home their cognitive competence was assessed within the first three months of the second year, and at 3 1/2 years they were seen in their homes for reevaluation of both cogntive competence and exploratory play.

Measures

One-Year Play Assessments

Infants were scheduled to be seen with their mothers and with their fathers for one hour apiece at the university infant laboratory at one

year of age. The order of these two visits were counterbalanced. Half the children were seen at 12 months with mother, half at this time with father. The second parent accompanied his or her infant for a 13-month lab visit. For the first 30 minutes of each visit, an examiner conducted the assessment of infant free and elicited play. These procedures provided information on infant performance, competence, and executive functioning.

Exploratory behavior: Free play. Parents accompanied their infants to the laboratory playroom and stayed with the child throughout the play session. Their involvement with the child was monitored and kept to a minimum by the play examiner, whose job it was to set out the toys and engage the parent in conversation in order to create a situation that would maximize the child's sense of security.

Using the procedure developed by Belsky and Most (1981), each infant was provided with two sets of toys to play with for up to 10 minutes apiece. A play narrator, working behind a one-way mirror, described the child's play acts into a tape recorder. At the completion of free play, the play narrator made an evaluation of the child's most cognitively sophisticated play acts using a slightly modified version of the Belsky and Most play scale. Reliability in the assessment of highest level of free play was tested by comparing the evaluations of the play examiner and the play narrator. Observers agreed about the child's highest level of free play at a rate exceeding 90%.

The play scale used to evaluate free play performance level was modified in two respects from that employed in the Belsky and Most (1981) investigation. This modified play scale appears in Table 1. In altering the scale for this study, the "Sequence Pretend" category was divided into two categories, labelled "Sequence No Story" and "Sequence Story," based on work by Fenson and Ramsey (1980). Additionally, during the elicitation procedure (see below), the categories of "Relational" and "Enactive Naming" were eliminated from the scale because of difficulties inherent in describing or modelling play acts at these two levels in the play scale.

Motivational expression: Executive functioning. In order to assess the highest level of elicited play, subsequent to the free play portion of the session each child was encouraged, via verbal suggestion and/or behavioral modelling, to engage in play activities more competent than the highest level behavior demonstrated during spontaneous play. To increase the likelihood that the child would follow the play examiner's lead, the examiner suggested activities within a play theme in which the child had shown interest and skill during free play, using materials s/he had already manipulated.

Whenever a child successfully demonstrated an elicited act, the examiner suggested another act within the same play theme, but at the next highest level in the play scale, first with a verbal suggestion, then with a behavioral model, and finally, with a verbal suggestion plus model. Once a child failed to demonstrate a desired play act across all three trials, the examiner introduced a new play theme at the same level. If, on the second set of trials, the child failed again, the examiner concluded that the child's level of competence had been reached. Although it is unlikely that all acts coded at a given level of play are of equal difficulty, it was assumed that by working with materials, and within a play theme, in which the child had already demonstrated interest during free play, and by providing a second opportunity within a new play theme, failure to carry out a play act was less likely to be the result of some factor other than surpassing the child's level of competence.

As with the assessment of performance (highest level of free play), reliability in the assessment of competence was tested on the basis of the play examiner's and play narrator's evaluations. Across 25 reliability assessments, observers agreed at a rate exceeding 90% that a child had successfully completed, or failed to complete, a play act encouraged by the examiner.

The notion that a child's highest level of elicited play could be considered a measure of competence, or the highest level of skill of which s/he is capable, receives support from research on imitation. Results of a variety of studies indicate that children do not blindly mimic a model, but demonstrate only those aspects of behavior that they understand and can assimilate (Harnick, 1978; McCall, Parke, & Kavanaugh, 1977; Scallon, 1976; Uzgiris, 1984; Watson & Fischer, 1980). These data suggest that children's responses to verbal suggestions and behavioral modelling may indeed represent a strategy for tapping their most advanced level of functioning, indicated here as "competence."

The comparison between free and elicited play employed here as the index of motivational expression was "executive functioning." This measure combines the conceptual strength of Belsky's difference score (highest elicited play level - highest free play level), reflecting the discrepancy between spontaneous and elicited exploratory play, with the pscyometric rigor of Hrncir's weighted sum, a score based on all spontaneous play, rather than only two pieces of data.

Executive functioning represents the sum of all observed manipulative (lower-level) and pretend (upper-level) play acts, weighted according to their discrepancy from the level of competence attained during elicited play. Manipulative and pretend play acts are figured into the computations separately due to the fact that pretend play (Levels 6-14 in the play scale) occurs much more infrequently than simpler manipulative exploration (Levels 1-5 in the play scale). By treating these two categories of play separately, more competent (and motivated) infants are not penalized for their relatively less frequent competence-level play acts. At the same time, levels of play within each category are collapsed to a certain degree in order to omit any differences between adjoining levels that are more qualitative than quantitative. These further modifications are detailed in Table 2.

Cognitive competence: The Bayley Scales. Within the first three months of the second year, following the visit to the lab with mother, infants were tested on the Bayley Scales of Infant Development. Evaluations were conducted at home by a trained examiner, who administered both the Bayley Scales and the Infant Behavior Record, the standardized behavioral rating scales that accompany it.

3 1/2-Year Follow-Up Assessments

The procedure for 3 1/2-year data collection involved two staffpersons visiting each family's home at a time when the child was well-rested. While mothers were interviewed, children were observed as they explored a novel stimulus in a distant corner of the same room or in an adjoining room, with ready access to mothers if desired. Following this period of data collection, mother and child were separated so child intelligence could be assessed. The staffperson who had previously interviewed the mother served as tester during this second phase of data collection.

Exploratory play: The Curiosity Box. As an index of children's exploratory motivation, observations were made of children's spontaneous exploration of the Banta Curiosity Box. The Curiosity Box, originally

constructed by Banta (1970), is a rectangular wooden box ornamented with manipulative devices and tactile elements, and containing several interior chambers holding various attractive objects which can be glimpsed through two hinged doors and panes of plexiglass. Each child was permitted to engage this curiosity-provoking stimulus for up to 10 minutes. Working with a stopwatch, checklist, and rating scales, the observer evaluated what the child did with the box and the affect s/he displayed during exploration. Affect and quality of play were rated at the conclusion of the play period using five seven-point scales (Nezworski, 1983).

Three summary scores, derived by standardizing and summing specific qualitative and quantitative measures of Curiosity Box exploration, were created on the basis of correlational patterns and conceptual convergence. The first of the summary scores, consisting of ratings on Self-Esteem, Affect, and Agency scales and the number of questions children asked during exploration, was given the label "agency." The second, consisting of the total number of manipulations observed, the number of sides of the Box explored, and ratings on a Level of Play scale, was labelled "information-gathering." The final summary score, consisting of children's total play time (out of 10 possible minutes) and ratings on an Involvement scale, was termed "involvement."

Cognitive competence: The McCarthy Scales. For the purposes of attaining a reliable and valid assessment of intellectual competence among the young children of the sample, the McCarthy Scales of Children's Abilities were administered by a trained examiner. Immediately following administration of the McCarthy Scales, the examiner completed seven behavioral rating scales. Like the Infant Behavior Record for the Bayley Scales, these rating scales, designed for use in the present investigation, strive to capture meaningful variation in the child's social and object orientation during testing. The five-point scales assess children's interest, dependency, persistence, cooperation, social involvement, activity level, and degree of comfort.

Results

Psychometric evaluation of the motivational measures used in this study will be described first, followed by results regarding concurrent relations between motivation and competence, and their continuity over time. On the basis of sample and effect size considerations, the alpha-level for tests of significance was set at 10%. Because the sample size was small to begin with and because some sex differences are indicated in the literature, a 5% probability level was deemed too stringent for this investigation, given the size of effects anticipated in several of the analyses. The relative increase in statistical power was believed to offset the somewhat greater risk of a Type I error.

Selective Attrition

Two MANOVAs conducted on relevant demographic variables obtained from families at the time of initial enrollment in the study, and a MANOVA on measures of infant functioning at one year (Bayley MDI and behavioral ratings, executive functioning, and free/elicited play discrepancy) revealed no systematic differences between children who did and did not remain in the study for the 3 1/2-year follow-up investigation.

Psychometric Issues

One-Year Executive Functioning

Significant sex or birth order differences on any of the one-year play or Bayley measures were not found for level of performance. However, it is worth noting that although play scores for boys and girls exhibited similar variance, girls' mental test scores (MDI and behavioral ratings)

were considerably more variable than those of boys ($F'(26,26) = 3.97$, $p < .001$ for MDI; $F'(26,26) = 2.50$, $p < .05$ for Bayley ratings). This was not the product of one or two highly deviant scores; Bayley scores were quite evenly distributed around the mean. With this qualification and in the absence of level differences, all data were combined for psychometric evaluation of the executive functioning measure.

Reliability. The correlation between 12- and 13-month executive functioning was substantial ($r(50) = 0.58$, $p < .01$) and was comparable for girls and boys. Executive functioning also demonstrated a moderate relation to Belsky's discrepancy measure, when each was assessed in the presence of mother ($r(53) = 0.39$, $p < .01$). In contrast to executive functioning, however, discrepancy scores did not exhibit stability from 12 to 13 months ($r(47) = 0.01$, N.S.).

Convergent validity. In order to examine concurrent relations between the two play-based measures of mastery motivation and an independent measure of motivational expression, both the executive functioning and discrepancy measures were correlated with a summary score of ratings (standardized and summed) obtained from the Bayley Infant Behavior Record. This summary score reflects infant cooperation during testing, responsivity to objects, attention span, and reactivity to the testing situation. The correlation between executive functioning and the Bayley rating summary ($r(48) = 0.32$, $p < .05$) was similar to that between Belsky's discrepancy score and Bayley ratings ($r(45) = 0.29$, $p < .10$), both very modest. In each case, the correlations were comparable for boys and girls. Although these correlations are only modest in magnitude, the fact that different methods of measurement were employed (behavioral counts versus rating scales) during different tasks (independent and elicited play versus structured problem-solving) in different settings (laboratory versus home) assigns theoretical significance to any reliable associations.

Discriminant validity. In accordance with the multitrait-multimethod framework formalized by Campbell and Fiske (1959), validation of the executive functioning measure should include not only correlations with conceptually similar measures, but the absence of relations with measures of independent constructs. Although it is assumed that motivation and competence are inherently interrelated, one would expect to find weaker relations between measures of motivation and competence than between different measures of motivation. This was tested by correlating the executive functioning and discrepancy measures with Bayley MDI. No relation was found between executive functioning and MDI ($r(48) = 0.08$, N.S.), and only a statistically unreliable one between the discrepancy score and MDI ($r(45) = 0.22$, N.S.).

In the case of executive functioning, however, the near-zero relation with MDI was the result of weak relations for both boys ($r(23) = -0.31$, N.S.) and girls ($r(25) = 0.25$, N.S.) that were in opposite directions. This difference is significant by Fisher's Z Transformation ($z^2 = 3.48$, $p < .10$), but due to the decreased sample size when analyses are conducted separately by gender, neither relation attained statistical significance in and of itself. Since these correlations across domains (motivation and competence) are, to some extent, comparable to those between multiple measures of motivational expression, the evidence for discriminant validity is equivocal.

Thus, executive functioning demonstrates some degree of construct validity in that it correlated significantly with infants' style of approach during standardized testing. It is probably not unrelated to

level of performance during testing (and shouldn't be, theoretically), but the relations in this case were more ambiguous, apparently qualified by infant gender. Relative to the discrepancy measure, executive functioning proved the more stable and hence, given the current information available on each measure, the superior of the two behavioral indices of mastery motivation for the purposes of this study.

3 1/2-Year Exploratory Curiosity

In order to assess the validity of the Curiosity Box scores as measures of mastery motivation, the three summary scores were correlated with independent ratings of children's behavior during administration of the McCarthy Scales. On the basis of intercorrelations between McCarthy ratings, two composite scores were constructed by standardizing and summing individual ratings. The first, labelled "comfortableness," consisted of chidren's communicativeness and level of anxiety during testing. The second, termed "motivation," included ratings of children's interest, persistence, and cooperation during testing.

Convergent Validity. Relations between McCarthy rating scores and scores for exploration of the Curiosity Box were, once again, very modest where they existed at all. Nonetheless, they are conceptually coherent and are similar for boys and girls. The Comfortableness rating during McCarthy testing was associated with the Agency score during exploration of the Curiosity Box ($r(35) = 0.30$, $p < .10$). Similarly, the McCarthy Motivation rating correlated with the Curiosity Box Involvement score ($r(35) = 0.33$, $p < .10$). Neither McCarthy rating summary score correlated significantly with the Information-Gathering score from the Curiosity Box, however, suggesting that this latter score may assess a distinct aspect of motivational expression from those indexed by ratings during testing.

Discriminant Validity. Associations between Curiosity Box measures and style of approach during McCarthy testing (behavior summary scores) were compared with those between Box scores and performance during testing (GCI). In contrast to the substantial correlation between the Motivation rating during testing and test performance ($r(35) = 0.49$, $p < .01$)--non-independent measures--none of the relations between Curiosity Box scores and GCI approached significance. In this case, unlike the results reported for comparable one-year data, the relations were quite comparable for boys and girls, providing somewhat stronger evidence for discriminant validity.

Concurrent Relations of Motivation and Competence

The correlations at each time of assessment between measures of mastery motivation and level of cognitive competence displayed during standardized testing have been reported. Relations between these independent measures of competence and motivation did not change significantly over time, although the sex differences that emerged at one year did not appear at 3 1/2 years.

Continuity in Child Functioning

A small number of significant associations within and across domains of child functioning were observed when the data were analyzed longitudinally. These are described below.

Motivation

Correlations between one-year executive functioning and 3 1/2-year motivation and competence were all close to zero when data were examined for the sample as a whole. Without exception, however, all predictive relations using one-year executive functioning were in the negative direction for boys (smaller discrepancy between maximal and typical play behavior presaging higher motivation and competence during preschool) and

the positive direction for girls (larger discrepancy presaging higher motivation and competence). Only one predictive relation reached statistical significance in each case, however. Among boys, the play-based measure of infant mastery motivation predicted later Agency scores during exploration of the Curiosity Box ($r(14) = -0.68$, $p < .01$). For girls, executive functioning predicted ratings for comfortableness during McCarthy testing ($r(19) = 0.47$, $p < .05$). The sex differences in the strength and direction of these two correlations are significant by Fisher's Z Transformation ($z^2 = 8.15$, $p < .01$ for the former; $z^2 = 3.72$, $p < .10$ for the latter). Infant boys who played at or near their level of competence later appeared confident, self-assured, and efficacious as 3 1/2 year olds during Box exploration. In contrast, 3 1/2-year-old girls who were sociable and non-anxious during McCarthy testing tended, as infants, to underutilize competencies during free play. With prompting from the examiner, these infant girls demonstrated higher-level play behaviors than those employed during free play.

Competence

For the total sample, performance on the Bayley Scales at one year predicted performance on the McCarthy Scales at 3 1/2 years ($r(30) = 0.36$, $p < .10$). It was not associated with any of the three Curiosity Box measures. However, just as a sex difference emerged in predicting the Curiosity Box Agency scores from earlier executive functioning, there was a sex difference in prediction of Agency from Bayley performance ($z^2 = 5.31$, $p < .05$). Once again, it was possible to predict boys' ($r(14) = 0.67$, $p < .01$) but not girls' ($r(15) = -0.15$, N.S.) self-assurance, self-esteem, and verbal curiosity during exploration of the Curiosity Box. Results of a regression analysis indicated that, of the two, only Bayley MDI shared unique variance with later Curiosity Box Agency. When the common variance between MDI and executive functioning was statistically controlled, MDI but not executive functioning bore a significant relation to later Agency ($F(1,12) = 3.79$, $p < .10$).

Discussion and Conclusions

Recognizing the important implication for later childhood of both cognitive ability and motivational factors that affect its use, this investigation was designed to explore the early nature, measurement, and development of cognitive and motivational functioning across the first three years of life. An initial goal was the refinement and psychometric evaluation of a play-based measure of mastery motivation during infancy.

The one-year measure of executive functioning, calculated as the weighted discrepancy between the highest level of elicited play for which an infant demonstrates competency and the total amount of manipulative and pretend play in which that infant engages during free play, proved to be reliable over a one-month period. Indeed, executive functioning demonstrated some cross-situational stability in that scores obtained in the company of mother and in the company of father were moderately correlated. Concurrent validity, evaluated against summed behavioral ratings during administration of the Bayley Scales, was also established. As expected, executive functioning proved to be of superior value for this study than the simpler discrepancy measure Belsky proposed (Belsky et al., 1984; Belsky and Hrncir, 1982).

Theoretical work on mastery motivation (Deci, 1975; Harter, 1978; White, 1959; Yarrow, Klein, et al., 1975) postulates a fueling effect of children's motivation on their behavior and their performance in relevant settings. In keeping with this theoretical formulation, then, cognitive-oriented measures of mastery motivation should exhibit positive

relations with concurrent and/or subsequent cognitive motivation and competence. Yet in the present investigation, this was only found to be true for male infants, using one-year executive functioning as the index of motivation.

Among boys, expression of greater mastery motivation at one year--indicated by use of higher-level competencies during free play--was associated with confidence and thoroughness during later exploratory play in the preschool period. Contemporaneous correlations at both ages were in the expected direction with independent measures of motivational behavior. But even for boys, it was not possible to establish significant predictive relations between early motivational behavior and a standardized measure of cognitive competence. Exploratory interest and initiative appeared to be stable, measurable characteristics in boys that were, at best, modestly associated with Bayley MDI in infancy, but were unrelated to intellectual functioning as it was assessed in later childhood. Given the motor basis of cognitive functioning during infancy, this pattern of relations makes some conceptual sense, however. One would expect to find that early indices of physical exploration and performance on infant developmental scales relying heavily on motor-based skills bear some relation to each other.

Behavior during free play for girls at one year simply did not fit the "nomological net" (Cronbach & Meehl, 1955) of cognitive-motivational functioning that captured boys' behavior in infancy. Girls who demonstrated higher-level skills when encouraged by an examiner--who didn't express mastery motivation by using their competencies in free play--were neither less competent at one year, nor less effective and assured during exploration at 3 1/2 years. If anything, these girls appeared to be at a slight advantage over their "more motivated" infant counterparts; in a testing situation at 3 1/2 years, they appeared less anxious and more communicative, qualitities that bode well for future school performance. In fact, this correlation may provide an important clue about the "meaning" of executive functioning scores for girls.

Recall that performance on the Bayley Scales and behavior during testing were considerably more variable for infant girls than for infant boys. It was also the case that Bayley behavior ratings and performance were highly correlated--for girls only ($r(27) = 0.78$, $p < .01$ for girls; $r(27) = 0.23$, N.S. for boys). Consider, then, a contextual factor that may affect not only Bayley and McCarthy performance, but also scores for executive functioning--namely, responsiveness to an examiner who interacts directly with the child. Perhaps all three measurement procedures pick up variance in social responsiveness that is of particular significance to girls' behavior and performance.

Such an interpretation is consistent with other research indicating that females may experience a greater proportion of social and/or verbal interaction during infancy than males (Beckwith & Cohen, 1983; Endsley et al., 1975; Goldberg & Lewis, 1969; Moss, 1967). Differences in experience could produce wider variation among girls in social responsiveness to adults, variation that affects their behavior and performance when it is evaluated in the context of social interaction. If social responsiveness plays an important role in girls' elicitation behavior, then the gap between elicited and free play might well predict the degree of comfort exhibited during later McCarthy testing. Some support for this interpretation comes from the fact that the highest level of elicited play (imitatation of examiner) correlated 0.53 ($p < .05$ for girls only) with 3 1/2-year Comfortableness ratings, whereas the highest level of free play

(independent of the examiner) correlated only 0.17 (N.S.). Among boys, the correlations were all non-significant, but in the negative direction, further suggesting that one-year executive functioning represents something quite different for children of each gender.

If executive functioning is an inadequate measure of female mastery motivation, is there any play index that does demonstrate some degree of construct validity for girls? In some ways, the highest free play score seemed better able to fulfill this role. Whereas free play performance among boys was unrelated to 3 1/2-year motivational measures, girls' highest level of free play was the only play index that bore some relation to measures designed to tap mastery motivation at preschool age. Free play performance was positively associated with later Agency during Box exploration ($r(16) = 0.44$, $p < .10$) and with the Motivation rating during McCarthy testing ($r(18) = 0.49$, $p < .05$).

In view of these findings, it is noteworthy that Jennings et al. (1984) found their only longitudinal prediction from girls' one-year motivational behavior using a comparable measure, described as "practicing emerging skills." Scores on this measure represent more frequent cognitively sophisticated acts during free exploration, much like free play performance scores in this study. To the extent that boys and girls do have different styles of exploration--including their willingness to separate from mother for exploration--the actual meaning of their competence and thoroughness in free play could well differ (Goldberg & Lewis, 1969; Martin, Maccoby, & Jacklin, 1981). At any rate, the notion that sophistication in exploration may provide a better index of motivational factors in girls' behavior during infancy merits attention in future studies.

By 3 1/2 years, there were no longer sex differences in performance on the play-based motivational measures. Correlations between competence and motivation scores at this age were far more consistent across gender. Presumably the presence of an unobtrusive observer during Curiosity Box exploration (like the examiner's presence during free play at one year) did not have the same impact on girls' behavior as did direct interaction with the examiner during both 1- and 3 1/2-year testing.

Although exploration of the Curiosity Box revealed fewer sex differences than did the earlier executive functioning measure, it was not associated with concurrent intellectual performance. It seems that the variance test ratings share with test performance is separate and distinct from the variance these ratings share with independent motivational measures, a conclusion Radin (1971) reached in her own work with school-aged children. What might prove more revealing of relations between motivation and competence are contemporaneous and predictive correlations between play-based mastery motivation and measures of school achievement. One could hypothesize that motivational differences and differences in intellectual ability contribute more or less independently to long-term performance in the academic sphere...or in any functional domain that calls for active, progressive, knowledge-acquisition. Certainly this has been found when classroom behavior serves as the basis for evaluating children's motivation (Feshbach, Adelman, & Fuller, 1977; Perry, Guidubaldi, & Kehle, 1979; see also Bloom, 1976).

Alternatively, it may be that reliable relations betwen motivation and competence measures require independent assessment within a given domain of functioning. Thus exploratory initiative and curiosity might be relevant only to competence in mechanical "know-how," in applied spatial relatiens or configural problems. Prediction of cognitive test

performance might call for measures of motivation specifically taken during school-like structured tasks. Harter's (1980) work, in particular, emphasizes specificity in motivational factors relevant to children's behavior.

Within a longitudinal framework, important relations also exist between early competence and later motivation. Whether one considers test competence in boys (Bayley MDI) or free play competence in girls, competence at one year predicts motivation scores at 3 1/2 years. Indeed, when one pits boys' Bayley MDI against executive functioning as a predictor of later cognitive-motivational functioning, Bayley scores win a clearcut victory. Bayley MDI correlated not only with 3 1/2-year GCI, but also with two of the three Curiosity Box measures. Bayley MDI for boys, like free play performance for girls, captured meaningful variance in motivational functioning during infancy as well as, if not better than, a "purer" measure of motivational expression.

Such an outcome is consistent with Scarr's (1981) notion of a "general competence factor" during very early childhood that only gradually emerges as two separate, but related, domains of cognitive functioning during middle and later childhood, namely, ability and motivation. The data provide stronger evidence, however, of a network of cognitive and motivational behavior that characterizes boys' functioning during infancy. Whether such a network can also be established for girls probably depends on investigation of a broader set of infant measures from a factor analytic perspective.

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Table 1

Belsky and Most (1981) Developmental Scale of Infant Play

Play Levels	Descriptions	Examples
1. Mouthing	Indiscriminate mouthing of materials	Mouthing a block or plastic donut
2. Simple Manipulation	Visually guided manipulation lasting 5 seconds	Turning over an object to examine the bottom
3. Functional	Visually guided manipulation that extracts unique information	Rolling a cart on wheels; Dialing a toy telephone
4. Juxtapose**	Juxtaposing two or more objects in a random manner	Touching a shell to a ring; Hitting a phone with a peg
5. Functional Relational	Integrating two objects in an "appropriate" manner	Placing a spoon in a bowl; Placing a peg in a pegboard
6. Enactive Naming**	Approximating pretend play	Touching a brush to one's head without making stroking motions
7. Pretend Self	Pretend play directed toward oneself	Bringing a toy phone receiver to one's head and vocalizing into it
8. Pretend External	Pretend play directed toward other	Feeding a doll with a spoon; Rolling a car with motor noises
9. Substitution Self	Giving a "meaningless" object meaning in the context of a "pretend self"	Bringing a peg to one's ear and vocalizing into it; Feeding a doll with a stick (as spoon)
10. Substitution External**	Giving a "meaningless" object meaning in the context of a "pretend external"	Feeding a doll with a stick; Pushing a block along the floor with motor noises
11. Sequence No Story	Repeating a single pretend act with a minor variation	Feeding self with spoon and feeding doll with spoon
12. Sequence Story	Linking two different pretend acts	Dialing a toy phone and talking into receiver

13.	Sequence Substitution	Incorporating a substitution into a "sequence story"	Dialing a toy phone and talking into a peg
14.	Double Substitution	Incorporating two substitutions into a "sequence story"	Stirring in a shell and feeding a doll with peg

**Play levels not modelled during the elicitation procedure

Table 2

Original and Reduced Belsky and Most (1981) Play Scales

Full Scale	Reduced Scale
Mouthing	Undifferentiated Exploration
Simple Manipulation	
Functional	Functional
Juxtapose	
Functional Relational	Transitional Play
Enactive Naming	
Pretend Self	Simple Pretend
Pretend External	
Substitution	
Sequence No Story	Elaborated Pretend
Sequence Story	
Sequence Substitution	
Double Substitution	